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7 The Washington Public Power Supply System: Nuclear Power Plants 1968-1992

7.1 BRIEF OVERVIEW

The Washington Public Power Supply System (WPPSS) was formed in 1957 as a construction and power generating arm of Washington State utilities. In October 1968 The Bonneville Power Administration (BPA), a federal agency, announced plans to build 19 or 20 nuclear power plants in the Pacific Northwest by 1990. This decision was supposedly based on energy forecasting needs by BPA and the Pacific Power Utilities Conference Committee, predicting brownouts in the 1980s and possible blackouts by 1990. WPPSS became the financier and contractor for five of these plants in the State of Washington, WNP-1, -2, -3, -4, and -5. BPA agreed to back the financial plans for WNP-1, -2, and -3 only. Eighty-eight public utility districts (PUDs) agreed to back municipal bonds for WNP-4 and -5 in 1976.

Waste and mismanagement plagued all five projects, with much rework required and costs escalating far beyond the original estimates of \$5.7 billion for the five plants. In January 1982, WPPSS canceled projects 4 and 5 after expending \$3.2 billion, including \$2.25 in municipal bonds. Projects 1 and 3 were “shelved” later that year after completing over 65 percent and 75 percent of the construction, respectively. Project 2 came on line in December 1984 at a cost of \$3.35 billion. WPPSS incurred a total debt of over \$24 billion by 1988, including default on \$2.25 billion in municipal bonds, litigation, and interest payments.

This chapter will examine and discuss the background of the five nuclear power plants, the myriad of problems encountered in design and construction, and demonstrate how an integrated planning and quality management system (IPQMS) could have avoided the many mistakes made.

7.2 BACKGROUND

The Washington Public Power Supply System (WPPSS) was created in 1957 as a construction and power generating arm of the Public Utilities Districts (PUDs) and city utilities. It is a joint operating agency, not a utility. Its mandated purpose is to finance, build, and operate power generating plants. As such, it is one of a number of power supply systems that furnish electricity for the Bonneville Power Administration (BPA) grid in the Pacific Northwest.

BPA was established in 1937 by President Roosevelt and Congress as part of the Public Works Administration (PWA) created by the federal government to institute and administer projects for the construction of public works across the country. BPA was under the Department of the Interior until the creation of the Department of Energy in 1977, its new home. It markets and transmits electrical power for the Pacific Northwest. The service area takes in the states of Washington, Oregon, and Idaho, Montana west of the Continental Divide, and some adjoining portions of Wyoming, Utah, Nevada, and California. The area encompasses 300,000 square miles and has a population of about 9 million.

BPA markets power for 30 U.S. multipurpose dams in the Columbia River Basin, which supplies almost half of the Pacific Northwest's electric power needs. Unlike the Tennessee Valley Authority, BPA cannot build its own generating facilities. BPA does pay the costs of thermal power plants whose power it acquires. This includes the WPPSS Project 2, called WNP-2. It encouraged the design and construction of WNP-1 and WNP-3, which will be discussed later.

The WPPSS or Supply System was initially governed by a board of directors made up of one representative from each member utility. There were 17 PUDs in 1957, and this body chose a seven-member executive committee to run the day-to-day business of building and operating its projects. Municipal utilities became members of the Supply System in the 1970s. These included Seattle, Tacoma, and Richland.

7.2.1 THE INITIAL WPPSS EXPERIENCE

In 1962, the board of directors approved the first Supply System project at Packwood Lake, about 20 miles southeast of Mt. Rainier. The hydroelectric project was financed by bond sales totaling \$13.7 million. It began operating in June 1964 and is expected to produce more than \$60 million in revenue over its lifetime. It has already produced more than 2 billion kilowatt hours of electricity. It has a capacity of 27.5 megawatts.

During the late 1950s and early 1960s, the Supply System also explored generating electricity using byproduct steam from a federal defense reactor used in World War II. The Atomic Energy Commission (AEC) had done extensive studies on the idea of a dual-purpose reactor at Hanford. When Congress turned down an AEC request to fund the generating plant, the Supply System drew up its own proposal.

On September 26, 1963, President Kennedy signed a bill that authorized the AEC to sell byproduct steam from the N-Reactor to the Supply System. The law stipulated that no federal funds could be spent on the generating portion of the plant and that half of its electricity would be offered to private utilities and the other half to public utilities. (The latter was necessary to overcome private power opposition to the project.) A \$122 million revenue bond sale was arranged to finance construction of the Hanford Generating Project (HGP). When completed in 1966, the HGP/N-Reactor complex was the largest nuclear power plant in the U.S. with a capacity of 860 megawatts. As of 1987, it had produced more than 65 billion kilowatt hours of electricity.

In 1987 the nuclear reactor at Hanford was shut down for safety improvements, placed in dry status in 1989, and in August 1991, the Secretary of Energy announced the decision to place the nuclear reactor in permanent shut-down in the future.* Thus, the action eliminated the original Hanford nuclear reactor as a steam source for the HGP. The HGP electric generators are at standby and being preserved by the WPPSS as a potential future energy source.

7.2.2 THE HYDROTHERMAL POWER PROGRAM

The Supply System's experience with these two projects, especially HGP, gave it an excellent reputation that greatly influenced the next series of regional power planning decisions. This was a cooperative venture with private utilities to build the thermal generating plants thought necessary to meet electrical loads through the end of this century. Because of its reputation, the Supply System was given an important part of this "Hydrothermal Plan". (Thermal power plants are those that use steam generated by coal, oil, gas, or nuclear reactors.)

The hydrothermal plan came in two parts. The first, made public in 1968, called for the construction of eight large plants, including the Supply System's first three units: WNP-1, -2, and -3. Despite the addition to these planned power plants, energy forecasters continued to project power deficits in the 1980s. The hydrothermal plan was revised to include eleven more

* See Chapter 9, The executive summary of the Hanford Nuclear Reservation.

generating units, including WNP-4 and WNP-5, which were planned to be built as twin units of WNP-1 and WNP-3 to take advantage of the cost savings of dual-unit construction.

By January 1975, the necessary agreements for WNP-4 and -5 had been drafted. Public hearings were held throughout the region as various PUDs, electrical coops, and city utilities decided whether to participate. Opposition to the two proposed units was minimal, although there were notable exceptions, such as Seattle City Light's decision not to participate, made after considerable debate.

Endorsements came from power authorities such as the Public Power Council, which represents the power supply and planning interests of the region's publicly owned utilities. The council urged each utility's "prompt and positive consideration" of participation in WNP-4 and -5, citing the region's demand forecasts and the expected low cost of nuclear energy from the two plants compared to other available generating alternatives.

In addition, BPA issued a "notice of insufficiency" in June of 1976 to its public utility customers. The notice stated that after June 20, 1983, BPA would not have enough power available to meet its utility customers' additional power needs.

Unfortunately, the energy needs forecasting was not analyzed critically by professional experts and the public and private utility districts. With five large nuclear plant projects implemented at the same time, financial chaos resulted, popularly known as the "WHOOOPS matter". Due to mismanagement and waste, construction costs escalated from the original estimates of \$5.7 billion to over \$20 billion. These costs included default of \$2.25 billion in bonds by the State of Washington, the first such default in the U.S.

7.3 RESULTS

[Table 7.1](#) presents a summary of pertinent information by plant number, with summary sheets for WNP-1, -2, and -3. WNP-4 and -5 are twin designs of WNP-1 and WNP-3, respectively.

7.3.1 COSTS AND SCHEDULES, WNP-1, -2, -3

These data were obtained from both WPPSS and a paper on "WHOOOPS" by John Boyer, Field Representative, the Associated General Contractors of America, Oregon Columbia Chapter, 1983.^{1,2} [Table 7.2](#) presents a summary of costs and schedules. Boyer's paper was presented at an East-West Center Seminar for "Training of Trainers for Managers of Public Works Projects", Honolulu, Hawaii, March 1983. WNP-2 cost information was confirmed by telephone interviews with Burns & Roe in 1987.

TABLE 7.1**Summary: General Information/WNP-1, -2, -3**

	WNP-1	WNP-2	WNP-3
Location	Hanford	Hanford	Satsop
Capacity	1250 Mwe ^a	1100 Mwe ^a	1240 Mwe ^a
Type	Pressurized water reactor	Boiling water reactor	Pressurized water reactor
Reactor	Babcock & Wilcox	General Electric	Combustion Engineering
Architect engineer	United Engineers	Burns & Roe	Ebasco
Construction manager	Bechtel	Bechtel	Ebasco
Private utility participation	0	0	30%
No. of public utility participants	104	94	103

^aMwe, megawatt electrical.

TABLE 7.2**Costs and Schedules (in \$ billions)**

	WNP-1	WNP-2	WNP-3
First official estimate	\$1.2 (9/75)	\$1.5 (6/73)	\$1.4 (12/75)
1982 construction budget ^a	\$4.3	\$3.35	\$4.9
Cost to complete ^b	\$1.5	0	\$1.4
First estimate of commercial operation	9/80	9/77	9/81
Current estimate of commercial operation	Indefinite	Dec. 13, 1984	Indefinite
Percent complete	65	Complete	76

^aPlant 2 entered commercial operation on December 13, 1984 which closed the books on construction costs at approximately \$3,350,000,000.00.

^bFigures do not include interest or preservation costs.

7.3.2 THE DECISION TO BUILD WNP-4 AND -5

These two plants were financed directly by WPPSS after 88 Public Utility Districts (PUDs) agreed to back tax-exempt bonds in July 1976. The original estimate for the two plants was \$2.60 billion, and WPPSS issued the first of

its long-term bonds in February 1977. Construction commenced with costly overruns, resulting in new estimates exceeding \$5 billion by July 1979. In March 1981, WPPSS issued the last of its \$2.25 billion in long-term bonds. It was estimated two months later that construction costs could escalate to \$12 billion. Construction was halted immediately. In January 1982 WPPSS canceled the two projects. The outstanding debt exceeded \$3.2 billion, and in July 1983 WPPSS defaulted on \$2.25 billion. Construction completion for WNP-4 and -5 was 24 and 16 percent, respectively. As of June 1991, substantially all the utility plant assets of WNP-4 and -5 were sold.

Nuclear power plants 4 and 5 were financed together as one utility system. All other WPPSS projects are financed separately. The BPA assisted in the funding of nuclear projects 1 to 3. The revenue bonds issued for each project are payable solely from the revenues of the projects.

Following the termination of WNP-4 and -5, a lawsuit was filed by 12 electrical cooperatives seeking relief from debt payments. The participants' agreement with the Power System provided that the public utilities participating will pay their respective share of annual costs, including debt service on bonds, whether or not the projects were completed. Debt service payments were due January 1983. However, as a result of the Washington State Supreme Court ruling declaring the participants' agreement invalid, payments were not made and a default occurred in July 1983.

Hundreds of attorneys nationwide were involved in dozens of lawsuits spawned by the default of WNP-4/5 bonds, construction termination (shelved) of projects 1 and 3, and other aspects of the WPPSS situation.

The total debt costs for all five plants, including interest but excluding litigation, had exceeded \$24 billion.

7.3.3 ATTEMPTS AT MANAGEMENT REFORMS WHICH CAME TOO LATE

In 1980, the Supply System board of directors made a mid-course correction, replacing senior management with a new team. Following is a brief synopsis of major management changes and initiatives undertaken by the new Supply System management:

- The Supply System projects were put in the hands of a new team of managers with considerable practical experience in building large nuclear power plants.
- The Bechtel Corp., one of the nation's more experienced nuclear power plant constructors, was brought in to manage construction at the three Hanford site projects.

- Steps were taken to reduce costs and unnecessary expenditures. The Supply System got out of costly uranium exploration projects and filed a successful lawsuit against the Exxon Nuclear Co. to hold that company to its original contract.
- The Supply System requested and received changes to state laws to negotiate for a single completion contractor at Plant 2.
- Labor stabilization agreements were negotiated at both Satsop and Hanford to avoid costly strikes over jurisdictional disputes. The number of work hours lost to such disputes fell markedly during 1981 and 1982.
- To identify the true costs to complete the projects, a “bottoms-up” review of all costs and schedules was ordered. The review took into account every yard of concrete, inch of pipe, and the best estimates available of interest rates and inflation.

In addition to the above, the Washington State Senate conducted an extensive investigation of the Supply System and its problems.³ One of its recommendations: “The WPPSS Board of Directors should be strengthened to improve its capability to set policy, oversee management performance, and maintain the financial viability of the projects.” It further recommended placing several individuals professionally trained in the management and construction of nuclear or other complex projects on the board and executive committee or replacing the executive committee with a full-time committee of professionals. (During most of its history, the Supply System was governed by a board of directors made up of one representative from each member utility. This body chose a seven-member executive committee to run the day-to-day business of building and operating its projects. Most of the board members were elected PUD commissioners or city councilmen from their respective utilities and cities. Some were farmers and ordinary citizens who knew nothing about nuclear plants.)

In 1981, the legislature acted on this recommendation, passing the first “board bill”. It replaced the executive committee with a new executive board made up of seven members from the full board and four additional members appointed by the full board from outside the Supply System. Subsequently, four distinguished northwesterners were appointed.

But the first board bill soon ran into trouble. The duties of the two boards were divided awkwardly, with the full board retaining such important powers as approval of construction budgets, appointment of treasurer, and approval of bond sales. In January 1982, three “outside” members abruptly resigned because the system of divided authority was unworkable. In 1982, the legislature passed the second board bill. It created a new executive board,

composed of five members drawn from the full board, three appointed by the governor, and three appointed by the full board from outside the Supply System orbit. The new executive board was given full power for managing the projects under construction. Thus, WPPSS appeared to have resolved its managerial problems regarding personnel at tremendous costs and loss of time. However, the financial and technical problems and related litigation resulted in the completion of only one power plant, with two canceled and two shelved.

7.4 WHAT WENT WRONG?

Initial estimates of \$5.7 billion in 1973–1975 ballooned to over \$24 billion by 1988 with only one plant on line (WNP-2), two terminated, and two shelved (WNP-1, 65 percent complete, and WNP-3, 75 percent complete).

The many factors involved in the huge cost escalation are discussed, showing how sound planning and good management *before* the five projects were designed and implemented could have prevented this financial disaster. The focus will be on the comprehensive feasibility studies that are an integral part of planning. Prior to this discussion, it is extremely worthwhile to summarize the highlights of the questions that should have been raised during the feasibility studies. This will enable us to pinpoint specific areas of investigation that were either ignored or treated lightly in this second stage of the project cycle (phase 1).

1. Economic study
 - a. Is the project responsive to an urgent present or anticipated economic social need?
 - b. Will the project's planned economic outputs adequately serve the intended purpose?
 - c. Will the services proposed to be performed through the project and the benefits produced by the project justify its cost?
2. Technical study
 - a. What are the costs of constructing and operating project facilities (and services), including machinery, equipment and spare parts, as appropriate?
 - b. What are the manpower requirements, from professional to labor, and are they locally available?
3. Administrative/managerial
 - a. Will the internal organization proposed to implement the project be comprehensive enough to provide the necessary leadership and unified control?

- b. Who will have complete responsibility and accountability for successful completion of the project?
 - c. Are there adequate personnel with the necessary skills for implementation of all project activities?
 - d. Are internal lines of communication well established and lines of authority clearly defined?
4. Financial study
- a. What are the magnitudes of the capital and operating costs of the project?
 - b. What are the sources of funds and draw-down schedules, and are they sufficient to cover costs of activities and implementation?
 - c. What is the projected cash flow of the project? To what extent are necessary borrowings scheduled to meet running deficits at activation?

The major problems encountered in the WPPSS financial mess are related directly to all items in the foregoing checklist of questions. The *real* need for five nuclear power plants in the 1970s to prevent the forecasted brownouts by 1985 and possible blackouts by 1990 was never challenged by the board of directors of the Supply System or any of the participating public utility districts and city utilities. Unfortunately, the Supply System had less than 100 employees with relatively little engineering and management expertise when the five plants were initiated. Thus, there was lack of adequate manpower and planning at the outset, exacerbated by lack of understanding of the complexities that would arise in attempting to design and build five nuclear power plants simultaneously.

Without the benefit of an IPQMS checklist, compounded by inadequate planning, the inevitable happened: mind-boggling financial chaos with only one plant on line by December 1984, the first-ever default of municipal bonds in the amount of \$2.25 billion in the U.S., and a total debt of over \$24 billion by 1988. Litigation is still on going and reports indicate WPPSS might have to sell the two “shelved” plants, WNP-1 and -3.

The Supply System did not understand how to cope with the changing regulatory requirements of the Nuclear Regulatory Commission (NRC) or the technological and systems problems inherent to lack of unified and competent control over the construction of all five large and complex projects. In addition, the simultaneous construction of five nuclear power plants in one state created an instant and enormous demand for both craftsmen and labor, escalating costs rapidly in both Washington and neighboring states. This resulted in economic depression of the construction industry in the region, with the State of Oregon especially hard hit.

7.5 EVALUATION

As envisioned the WPPSS projects looked great. Five nuclear plants that would have cost \$5.7 billion would contribute an additional 7.2 megawatts of electricity to the Pacific Northwest grid. Attractive revenue bonds sold very well to finance the projects. The projects enjoyed the highest favorable ratings in Wall Street. In the end, however, \$24 billion were spent, with only 1.1 megawatt harnessed on WNP-2. What really happened? To understand this debacle, the authors analyzed the projects in the IPQMS framework. These analyses, coupled with various reports, including those obtained from the Washington State Senate Energy and Utilities Committee,³ resulted in the following:

- Lack of leadership and expertise of the board of directors and top management on nuclear energy development and construction.
- Lack of accountability, teamwork, and coherence between the various participants, such as the WPPSS board and top management, architects/engineers, contractors, labor force and a number of public agencies such as BPA.
- Lack of quality control measures that should have been based on comprehensive feasibility studies (as outlined in the previous section).
- Absence of realistic, disciplined budget and schedule processes and effective mechanisms to use these processes in management of the projects.
- Failure to develop schedules that integrated construction, engineering, and procurement. It was observed that there were at one time 40 to 65 contractors, small and large, working in one location.
- Confusion on the appropriate contracting methods, formats, and contractual terms. Change orders costing millions of dollars, not subject to open-bid competition, became a standard. WPPSS started with fixed price contracts, then went to target man-hour terms, and later unit price/level of effort plus fixed-fee terms.
- Missed, crossed and blocked communication lines between the WPPSS and the contractors, consultants, Nuclear Regulatory Commission, state legislature, and BPA, despite the presence of hired technical staff of many man-years of experience in nuclear energy.

Overall the WPPSS lacked an effective corporate mission and philosophy. As an organization it became a bureaucratic nightmare. There was an almost limitless inflow of money coming from the efficient sales of bonds nationwide. It was believed that money could solve problems of waste, misman-

agement and incompetence. Even when construction deteriorated, no one would take responsibility and there was no accountability for the failures. There was finger-pointing, buck- and paper-passing, and a general no-care attitude as long as everyone on the project got their share of the jobs and contracts.

This postmortem clearly shows all principals involved with the five nuclear power plants must share the responsibilities for the many problems. In addition, the media must be faulted for ignoring the growing financial crisis. In short, criticism must be directed at the following groups:

- WPPSS top management and the board of directors: The board of directors was composed of rural folk, farmers, ranchers, and small businessmen who did not know much about nuclear power generation. They abandoned their policy-making and program formulation power to top management. The board did not ask the why and wherefore of proposals, and many times, the board would approve multimillion dollar cost overruns with little or no discussion. The way events unfolded, the top management and the board were responsible for mismanagement, wastage, cost increases, schedule confusion, and delays. The BPA, the architects/engineering (A&E) staff, the numerous consultants, the contractors, and labor unions, and other project groups contributed to the poor and hurried decisions of top management and the board of directors. The ultimate responsibility, however, rested on the board and top management. With simultaneous construction of five nuclear plants, of two different designs, at three different locations, with thousands of workers on site, the top management and the board found itself in dire straits.
- Architects and engineering firms: They were hired to design the plants and manage the construction process. On a fast-track arrangement, construction commenced even when designs were incomplete. The blueprints did not come as timely as they should. Many high crews were idle for months waiting for the plans. Unfortunately, they had to be paid just the same. The A&E companies sometimes blamed the Nuclear Regulatory Commission (NRC) for the delay. They claimed decisions were to emanate from the NRC on critical design aspects of the projects.
- Contractors: Many contractors, winners of a very large number of low-bid contracts, were not qualified to perform. Numerous pieces of work had to be redone to conform to specified quality. With such repeat activities in the work areas, there were huge delays in schedule. The first contract approach to projects was on the basis of man-

hours spent. This led to contractors stretching out the job for as long as they could. WPPSS then switched to fixed-cost contracts which became easily amendable through change orders. Without monetary and schedule constraints, performance was relinquished to the background.

- **Labor unions:** Labor unions, using the threat of strikes to settle disputes, disrupted work and threw schedules off. Delays in the sites costs millions of dollars a day. Labor unions demanded and received some of the best wages and benefit packages in the country.
- **Consultants:** Consultants for engineering, financial, legal, and other aspects of the projects were hired by the WPPSS to give the system an objective view to turn things around. The objective view never came, the status quo remained, and matters degenerated all the more. The consultants fed heavily from the fees paid them.
- **Washington State government:** The state legislature failed to act early despite the incoming flow of bad information. The lawmakers waited too long to institute changes in the composition of the board of directors. They were not successful the first time they did, and had to reorganize the board again. They failed to devise a less painful remedy bailout or settlement that would have distributed the cost of the default for WNP-4 and -5 in an equitable, or at least acceptable, manner. The bondholders should not have been left holding the empty bags. The legislative inaction was a result of weak political leadership. The legislators embraced wholly the statement that although WPPSS was created by state law, it was not normally subject to state oversight. Its directors were not appointed by state authority. The WPPSS was a creature of the participating public and private utility districts, with participants in several states and therefore subject to contractual oversight by a federal agency, not by the state. The passing of the buck was crucial to the failure.
- **The Bonneville Power Administration:** The BPA convinced and possibly applied pressure to WPPSS participant utilities to accept erroneous power forecasts to justify the Ten-Year Hydrothermal Power Program. This led to the decision to build nuclear plants in the state. BPA, supposedly doting father to the projects, failed to recognize the problems early enough. It lacked the foresight to develop and improve project management. Later, it became obsessed with trying to control administrative details when mismanagement problems became more obvious. BPA even became a

protagonist to the WPPSS in the 1970s during the System's public relations campaign.

- **Courts:** The Washington State Supreme Court decision on June 15, 1983 invalidating the take-or-pay, or so-called "hell-or-highwater" contracts for WNP-4 and -5 resulted in the default. However, events since the default indicated that at least some of the utility companies never could have raised their electric rates high enough to pay for their shares of the bond payments. They would have surely lost industrial customers and gone bankrupt anyway. In short, long-term default would have occurred even if the validity of the contracts had been upheld in court.
- **The federal government:** Congress and federal regulatory agencies such as the Nuclear Regulatory Commission (NRC) and the Securities and Exchange Commission (SEC) just stood by as observers while most of the WPPSS debacle was taking place. The NRC action on design clearances was slow. Contractors and workers were idled for days and weeks waiting for the design and plan clearances from the NRC. The Congress and federal agencies, with its silence on the very important questions of policies, created vacuums of responsibility in areas of industrial nuclear power development, regional power planning, municipal financial disclosure, quality assurance in construction, and default crisis resolution. These vacuums were filled by other groups whose interests were not broad enough to serve public purposes adequately.
- **The news media:** The media ignored the brewing story of the WPPSS drama until it was too late. The WPPSS was allowed to construct and operate in virtual isolation. The late entry of the news media came about only because the BPA hiked electricity rates in the 1970s that led to a public outcry and demanded explanation from the BPA and WPPSS. The BPA rate hike was passed on to the consumers through their respective utility companies. Public debate and news leaks contributed to the growing hostilities between BPA and WPPSS that worsened the problem. By the early 1980s many journalists were writing about contract frauds and managerial incompetence.

7.6 LESSONS LEARNED

Two basic lessons emerge from the evaluation of this postmortem. The first is the financial and managerial chaos that results from a combination of lack

of comprehensive feasibility studies and no accountability. Economic justification, such as costs and benefits, would clearly challenge the real need for five nuclear power plants to be designed and constructed simultaneously. This challenge would have been reinforced by the administrative and managerial studies that would show WPPSS could not provide the necessary skilled manpower to oversee the work of the design professionals — the architecture-engineering (A&E) firms.

The second lesson clearly showed that the role of policy as articulated in [Chapter 2](#) was simply not there, including BPA, Washington State, and the Nuclear Regulatory Commission. Indeed, experience shows that policy makers usually do not emphasize the importance of planning to the future success (or failure) of projects (see [Chapters 6, 8, and 9](#)). This is unfortunate because policy should be the unifying force in the IPQMS.

There are a number of related lessons from this postmortem, as follows:

- The need for detailed guidelines and checklists based on carefully prepared feasibility studies, whether the project is fast tracked or not.
- There was no compelling need for five nuclear power plants to be constructed, partly because the projections provided by the supposed authorities were not analyzed critically. This problem became more critical when it was decided to build the plants at the same time, of different designs, at various locations.
- Management studies and reforms for WPPSS were necessary even before undertaking the planning, design, and construction of *one* nuclear power plant. These reforms should have included attention to the composition of the board of directors, personnel needs and skills, contract process, project management, scheduling and reporting procedures, and other aspects to implement the projects efficiently.
- The need for teamwork among utility districts, through the board of directors, legislators, managers, planners, designers, constructors, and other participants in the projects.
- The need to pinpoint responsibility and accountability for the various component parts of the project, from conception through completion.
- The policy was not clear on whether public utilities districts that did not have expertise in nuclear energy generation should have been given the latitude to build nuclear power plants.
- The oversight role of either the federal agency (BPA) or the state was not clearly defined.

- The cash flow and other financial and manpower requirements of the project should have been thoroughly understood by all responsible parties, including the ratepayers who will eventually take the brunt of repaying the loans.

The lessons learned from the WPPSS mismanagement of the planning, design, and implementation of five nuclear power plants, coupled with an international study of nuclear operations from 1975 to 1984 (by Kent Hansen et al.) provide a number of insights.⁶ Ever-changing safety regulations and environmental concerns hamper both the construction and operation of plants in the U.S. The construction delays are readily apparent in [Table 7.3](#), where Tokai 2 was completed on its original schedule some six to seven years ahead of three plants in the U.S., including WNP-2.

TABLE 7.3
Plant 2 Schedules Compared with Contemporary Boiling Water Reactors^a

Event	Plant 2	LaSalle 2	Susqueanna 2	Tokai 2
Construction permit issued	Mar. 19, 1973	Sept. 10, 1973	Nov. 2, 1973	May 31, 1973
Fuel load commenced	Dec. 25, 1983	Dec. 17, 1983	Mar. 24, 1984	Dec. 23, 1977
Full power license	Mar. 30, 1984	Mar. 23, 1984	June 17, 1984	N/A
Commercial operation	Dec. 14, 1984	April 20, 1984	Feb. 12, 1985	Nov. 28, 1978

Note: All plants in the illustration above are boiling-water reactors in the 1100 megawatt range using General Electric reactors. As noted, all four started at roughly the same time, but only the Japanese power plant, Tokai 2, was completed on its original schedule.

^a LaSalle 2 was built by Commonwealth Edison Co. of Illinois, Susquehanna 2 by Pennsylvania Power & Light Co., and Tokai 2 by Japan Atomic Power Company.

In general, nuclear power plants in France, Japan, Sweden, Switzerland, and West Germany outperformed U.S. plants in both design categories: pressurized-water reactors and boiling-water reactors. Each country has its own independent regulatory agency such as the U.S. Nuclear Regulatory Commission (NRC) to set operating guidelines. However, two major differences stand out between the U.S. and the five other countries:

1. Teamwork between utilities and suppliers regarding information exchange, equipment improvement, and self criticism (feedback).
2. Foreign utilities have a healthier attitude on (a) pursuing long-term gains rather than short-term savings, e.g., huge contract awards to

very few competent and reliable contractors instead of the many low-cost bidders who could not deliver the product; and (b) providing short-term savings, in-house training programs, academic-degree programs, and staff exchange programs for improving the quality productivity of their staff members at all levels.

In summary, the nuclear power industry in the U.S., if it expects a resurgence, must initiate planning, design, and management reforms that will promote both long-range planning and teamwork to ensure accountability, cost effectiveness, and quality. Again, the lessons from the past show the need for an integrated planning and quality management system with checklists on quality control to meet these objectives.

7.7 EPILOGUE

The WPPSS continued to improve its administrative and managerial capabilities in the late 1980s. With assistance from the Pacific Northwest Congressional Delegation and BPA, a refinancing effort for the debt incurred in WNP-1, -2, and -3 was effected. This effort enabled WPPSS to re-enter the bond market in late 1989. The Supply System was authorized to issue up to \$2 billion in advance refunding funds before 1992.

The sale of utility plant assets of WNP-4 and -5, coupled with BPA guarantees in 1991, enabled WPPSS to market \$3.3 billion in WNP-1, -2, and -3 bonds as part of the refinancing plan. This refinancing, coupled with increased utility rates and tax credits, had reduced the outstanding debt to \$17+ billion by June 1991. Since then, WNP-2 was finished, while projects 2 and 3 are still mothballed “waiting” for the proper time when the projects shall be resumed again. There is news that they might well wait forever.

According to Leigland and Lamb, the various roles of the participants in the WPPSS fiasco have been revised and redefined:⁴

1. A formalized regional planning process is now a reality in the Pacific Northwest. The process involves the public and private power utilities, academic community, legislature, the BPA and other parties.
2. The NRC has refocused some of its attention to management quality, in both hardware and human resources. The NRC wants to ensure quality in all current and new projects.
3. The Securities and Exchange Commission investigated the possibility of new regulations for the investment community.

4. Bond attorneys and bond holders are now more wary of the risks involved, and are testing contracts before they are signed, or recommending precautionary legislation.
5. Rating agencies have developed more sophisticated criteria to evaluate the overall track records of public authorities.
6. Voters and ratepayers in the Pacific Northwest are more carefully monitoring the activities of their public officials to ensure accountability and cost effectiveness.

The WPPSS saga reinforces the need for a unified, comprehensive system of project development and management as enunciated by the IPQMS to prevent chaos in all aspects of the work.

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